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(54) **Modular knee prosthesis**

Moduläre Knieprothese

Prothèse de genou modulaire

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Description

Background of the Invention

[0001] This invention relates to joint prostheses, and more particularly to modular knee joint prostheses employed during knee arthroplasty procedures.

[0002] Knee arthroplasty is a well known surgical procedure by which a diseased and/or damaged natural knee joint is replaced by a prosthetic knee joint. Typical knee prostheses include a tibial component, a femoral component, and a patellar component. The femoral component generally includes a pair of spaced apart condylar portions, the superior surfaces of which articulate with a portion of the tibial component. A femoral stem assembly can also be used to provide lateral stability to the replaced knee joint. Femoral stem assemblies often include a stem member which seats within the medullary canal of a distal portion of a femur. The stem is typically coupled to the femoral component by a specialized collar and bolt.

[0003] Knee joint prostheses are available as modular assemblies to reduce the number of individual components that must be purchased and stocked, and to reduce the associated component handling time by the surgeon during arthroplasty procedures. An example of a prior art modular knee prosthesis is described in U.S. Patent No. 5,152,796 (Slamin). The Slamin patent describes a modular knee prosthesis that includes a femoral component and a series of bolts that attach to and extend from the femoral component at different angles corresponding to different valgus angles. The valgus angle is defined as the angle between the center line of the femur and the vertical axis connecting the distal femur and the center of the femoral head, and is typically between 5° and 9°. The prosthesis also includes a plurality of femoral stems having different lengths and diameters.

[0004] Despite existing modular knee joint prostheses, there remains a need for a modular knee joint prosthesis that has sufficient versatility to accommodate differing patient anatomy and joint conditions. Many modern modular knee prostheses are characterized by a relatively excessive number of components with little or no part interchangeability. Such systems tend to increase purchasing costs because of part waste. Additionally, the excessive number of parts must be handled and stocked, thus increasing costs associated with inventory control and management.

[0005] It is thus an aim of the invention to provide a modular knee prosthesis having sufficient versatility to accommodate different patient anatomy and joint conditions while maintaining a relatively low component count. It is another object of the invention to provide a modular knee prosthesis having components that are physiologically and geometrically compatible with different anatomical conditions. Still another object of the invention is to provide a modular knee prosthesis that is suitable for use in both right and left knee procedures. Other general and more specific objects of the invention will in part be apparent from the drawings and description which follow.

Summary of the Invention

[0006] The present invention relates to a modular knee joint prosthesis having improved versatility while reducing the overall component count. Components of the modular prosthesis of the invention are able to be used with both right and left side prostheses.

[0007] The modular knee prosthesis of the invention provides, as claimed in claim 1 hereinafter, a femoral component having a pair of spaced apart condylar portions each having a superior, articulation surface and an inferior surface. A boss structure is present on the femoral component and is disposed between and connects the condylar portions. The boss structure has an inferior surface that extends, in a first orientation, generally horizontally, in a transverse plane, and an opposed superior surface which has an aperture of a selected configuration. The modular knee prosthesis of the invention further includes an elongate stem member that mounts within the medullary canal of a distal portion of a femur. The stem member preferably has an open, distal end that is adjacent to the femoral component.

[0008] The modular knee prosthesis also includes a collar and at least one securing bolt. The collar mounts on the external end of the stem member, and has a distal surface that is substantially transverse to a longitudinal axis of the stem member when mounted thereon. According to one practice of the invention, the collar distal surface and the inferior surface of the boss structure define a selected mounting angle therebetween that is preferably between about 0 and 9 degrees.

[0009] The securing bolt, which is adapted to mount within the aperture of the boss structure, has a head portion with a spherical boss-engaging surface from which an elongate shaft portion extends.

[0010] The shaft portion of the bolt is disposed at and extends from a non-centrally located position of the head portion, such that the shaft is offset from center. Advantageously, providing a modular knee prosthesis with a single stem and with at least two collars having different mounting angles and offset securing bolts reduces the number of necessary prosthetic components, while providing a modular knee prosthesis that has improved versatility and which is suitable for use, without modification, in both left and right prostheses.

[0011] According to another practice of the invention, the securing bolt seats within and engages the aperture of the boss structure. More specifically, the superior articulating surface of the boss structure preferably includes a cavity that ends in a spherical endwall that houses the boss aperture. The mating engagement of the spherical surface of the bolt head and the spherical endwall of the cavity allows the bolt to be positioned

within the aperture at a selected angle relative to the transverse plane. The exact angle at which the bolt shaft portion extends from the inferior surface of the boss structure is determined by the collar mounting angle. According to one aspect, the aperture formed within the boss structure has a selected shape and can be elongated in either the anterior-posterior direction or medial-lateral direction.

[0012] According to a further aspect of the invention, the head portion of the bolt includes a first anti-rotation element for preventing unwanted rotation of the bolt when the bolt is mounted within the boss aperture. Additionally, the boss structure includes a second anti-rotation element, which engages the first anti-rotation element of the bolt, for preventing rotation of the bolt when mounted within the boss aperture. In one embodiment, the second anti-rotation element is formed on the superior surface of the boss structure.

[0013] A third anti-rotation element may be associated with the collar for preventing rotation of the collar when mounted on the inferior surface of the boss structure. The inferior surface of the boss structure preferably includes a fourth anti-rotation element, which engages the third anti-rotation element of the collar, for preventing rotation of the collar when mounted on the boss structure. The fourth anti-rotation element is preferably formed on the inferior surface of the boss structure.

[0014] The modular knee prosthesis of the invention can include a locking element, e.g., a snap-ring, that secures the collar to the elongated stem member. The locking element is preferably disposed in an interference fit with the collar and stem.

[0015] In a preferred embodiment, the elongate stem member is rotatable about its longitudinal axis independently of the collar.

Brief Description of the Drawings

[0016] The foregoing and other objects, features and advantages of the invention will be apparent from the following description and the accompanying drawings, in which like reference characters refer to the same parts throughout the different views.

[0017] FIG. 1 is an unassembled perspective view of a modular knee prosthesis according to the present invention that includes a right knee femoral component, but that is generally designed for use in both right and left knees.

[0018] FIG. 2A is a perspective view of one embodiment of a femoral component for use with the right knee and for use with the modular knee prosthesis of FIG. 1.

[0019] FIG. 2B is a perspective view of another embodiment of a femoral component useful with the modular prosthesis of FIG. 1, and that is designed for use in both right and left knees.

[0020] FIG. 3 is a bottom view of the femoral component of FIG. 1.

[0021] FIG. 4A is a side view of one embodiment of a securing bolt not encompassed by the invention.

[0022] FIG. 4B is a top view of the securing bolt of FIG. 4A.

[0023] FIG. 5A is a side view of an alternate embodiment of a securing bolt useful with the modular knee prosthesis of FIG. 1.

[0024] FIG. 5B is a top view, from the shaft, of the securing bolt of FIG. 5A.

[0025] FIG. 6A is a side view of a collar useful with the modular knee prosthesis of FIG. 1.

[0026] FIG. 6B is a top view of the collar of FIG. 6A.

[0027] FIG. 6C is a cross-sectional view of the collar of FIG. 6A taken along line B-B of FIG. 6B.

[0028] FIG. 7 is a cross-sectional view of the femoral stem of FIG. 1 along line A-A.

Detailed Description of the Invention

[0029] As illustrated in FIG. 1, the modular knee prosthesis 10 of the invention includes a femoral stem 14, a collar 26, a femoral component 40, and a securing bolt 56. The knee prosthesis 10 can further include a snap-ring 12, similar in type and operation to that described in U.S. Patent No. 5,152,796. The illustrated modular knee prosthesis 10, except the illustrated femoral component, is suitable for use, without modification, as either a left or a right knee prosthesis.

[0030] Referring to FIGS. 1 through 3, the femoral component 40 has a pair of condylar portions 42A, 42B that are connected by an intercondylar region or boss 44. The femoral component 40 has a superior articulation surface 45 and an opposed inferior surface 46. Further, the femoral component 40 has a posterior side 36 and an anterior side 38. The anterior side 38 of the femoral component 40 includes a patellar groove 54, shown in FIG. 3, within which seats a patellar prosthetic component (not shown). The superior surfaces 45 of the curved condylar portions 42A, 42B articulate with a prosthetic tibial component (not shown) mounted on the head of the tibia, in a manner well known to those of ordinary skill in the art.

[0031] The boss structure 44 has a pair of substantially vertical side walls 44A that are generally orthogonal to a top, inferior surface 44B. The top surface 44B preferably has formed thereon a pair of raised ridges 44C that constitute a collar anti-rotation element, as described in further detail below.

[0032] With reference to FIGS. 1 and 3, the boss 44 further has a cavity 70 formed within a bottom superior surface 44D. An aperture 78 disposed within the cavity 70 extends between the superior and inferior surfaces 45, 46, respectively, of the boss structure 44 and has a selected shape such that it can be elongated either in the anterior-posterior direction or the medial-lateral direction. Preferably, aperture 78 is elongated in the anterior-posterior direction. The shape of the aperture can be elliptical, oval, spherical, or of any other suitable shape that allows a sufficient amount of translation of

the securing bolt shaft when the bolt is mounted within the aperture.

[0033] The transverse plane is defined as the horizontal plane that extends through the knee of an upright subject and that is orthogonal to both the coronal plane and the sagittal plane, as will be appreciated by those having ordinary skill in the art.

[0034] The cavity 70 preferably has a pair of arcuate medial and lateral side walls 72, and a pair of substantially flat anterior and posterior side walls 74 that form a bolt anti-rotation mechanism, as described in further detail below. The cavity further includes an endwall 76 that has a substantially spherical or rounded shape for seating a correspondingly shaped head of the securing bolt 56.

[0035] The inferior surface 46 of the condylar portions 42A, 42B forms a series of integral surfaces that extend between the anterior and posterior sides of the femoral component. Referring to FIG. 1, the inferior surface of each condylar portion 42 comprises an anterior vertical surface 80, an axially spaced and downwardly extending canted surface 82, a substantially horizontal surface 84, an axially spaced and upwardly extending canted surface 86, and a posterior vertical surface 88. The horizontal surface 84 of each condylar portion has an indentation 90 that extends partly into the inferior surface of each condylar portion. The indentation allows the surgeon to grasp and handle the femoral component via a suitable handling instrument.

[0036] The femoral component 40 and boss 44 can have a variety of shapes, as shown in FIGS. 2A and 2B. Elements of the femoral component 40' which are common to the elements of the femoral component of FIGS. 1 and 3 are designated with like reference numerals with a superscript prime for FIG. 2A components, and with a superscript double prime for FIG. 2B components. The femoral component 40' of FIG. 2A has a boss structure 44' that has a second selected shape. Additionally, the illustrated raised ridges 44C' forming the collar anti-rotation mechanism are axially offset relative to each other. With reference to FIG. 2B, the boss structure 44" of the illustrated femoral component 40" has a third preferred shape. The raised ridges 44C" of the boss structure are also axially offset, similar to those of FIG. 2A. Those of ordinary skill will readily recognize that other shapes of the femoral component 40, boss structure 44 and condylar portions 42 exist.

[0037] FIGS. 4A - 5B illustrate embodiments of a securing bolt. With reference to FIG. 4A, the bolt 56 has a shaft portion 58 that extends upwardly and outwardly from a bolt head 60. The shaft has a lower unthreaded portion 58A that has an outer diameter (D1) less than the outer diameter of bolt head 60, and an upper, threaded portion 58C that is integral with the lower unthreaded portion 58A. Preferably, an indented neck portion 58B separates the upper and lower portions 58C, 58A of bolt 56. The outer diameter (D2) of the upper portion 58C is preferably slightly less than the outer diameter (D1) of the lower shaft portion 58A.

[0038] The bolt head portion 60 has a boss aperture-engaging surface 62, and an opposed, top surface 64 that includes a pair of canted surfaces 64A that join at an apex 64B. The aperture-engaging surface 62 preferably has a rounded or spherical shape complementary to that of the endwall 76 of the boss cavity 70. The mating engagement of the aperture-engaging surface 62 of the bolt head 60 and the shaped endwall 76 of the boss cavity 70 preferably positions the bolt shaft within the aperture. The bolt shaft 58 extends from the boss top surface 44B at a selected angle determined by the shape of the aperture 78 and by the mounting angle of the collar 26. The shape of the aperture 78 helps determine the allowable angle range of the bolt shaft by allowing the bolt shaft to translate within the confines of the aperture, and to eventually seat at a selected position therein, as described in further detail below. Although the endwall 76 and aperture-engaging surface 62 are shown with spherically-shaped contours, those of ordinary skill will recognize that other compatible configurations are possible.

[0039] As illustrated in FIG. 4B, the top surface 64 of the bolt head 60 has a peripheral surface 66 that is defined by a pair of opposed, arcuate sides 66A and a pair of opposed, substantially flat sides 66B. The flat sides 66B matingly engage the flat side walls 74 of the boss cavity 70 and cooperate therewith to secure the bolt within the cavity and to prevent unwanted rotation of the bolt when secured therein.

[0040] With further reference to FIG. 4B, the bolt is constructed such that the shaft portion 58 of the bolt extends from a generally centrally located position on the bolt head 60. This arrangement allows the bolt shaft to extend from the inferior surface of the femoral component when the bolt is mounted within the boss aperture at a selected location and desired angle relative to the inferior surface 46.

[0041] FIGS. 5A and 5B illustrate the securing bolt 56 constructed according to the invention. Bolt 56 is similar to that described above and shown in FIGS. 4A and 4B, except that the shaft 58 is positioned on the bolt head 60 in an offset, non-centered position. As illustrated, the shaft portion 58 of the bolt extends upwardly from a position axially offset a selected distance from a generally centrally located position of the bolt head 60. The distance by which the shaft is offset from this generally centrally located position is in the range of about 0 mm to about 5 mm. Preferably, the offset distance is about 2 mm.

[0042] This offset construction of the bolt 56 allows the bolt shaft 58 to extend from the boss inferior surface 46, when the bolt is mounted within the boss aperture, at a selected angle and axial orientation relative to the inferior surface 46 of the femoral component 40. For example, an offset bolt (FIGS. 5A and 5B) oriented in either an anterior or posterior direction may be necessary for differing anatomies, or where bony deficiencies exist in

certain areas of the femur.

[0043] The offset bolt illustrated in FIGS. 5A and 5B can be used in both right and left side prostheses where an anterior or posterior, or medial or lateral offset is needed.

[0044] With reference to FIGS. 6A and 6B, the collar 26 has a central body portion 28 that has an outer peripheral surface 29 and a boss engaging surface 30. The collar further includes a neck portion 32 that extends upwardly from a stem-seating surface 31. The neck 32 preferably includes a first annular portion 32A and a stepped annular portion 32B. A lip 32C formed along the top of the second stepped annular surface 32B overhangs the first stepped surface 32A. The distal end of the stem 14, when assembled with the collar, preferably engages the stem-seating surface 31, which is sized to receive femoral stems having various diameters, including diameters of about 13 mm and about 15 mm.

[0045] The boss engaging surface 30 is preferably canted and forms an angle with the transverse plane 22. The engaging surface 30 and the top, inferior surface 46 of the boss 44, which lies in the transverse plane, form a mounting angle (α) when the collar is assembled with the femoral component and engages the boss top surface. The angle (α) is preferably between about 0° and about 15°. According to one practice of the invention, the boss engaging surface 30 can be canted in the anterior-posterior direction to either the anterior or posterior side as measured in the sagittal plane. Likewise, the surface 30 can be canted in the medial-lateral direction to either the medial side or the posterior side as measured in the coronal plane. Preferably, the angle (α) can range between about 0° and about 15° in any direction. This varied collar angulation provides a plurality of stem mounting angles which is compatible with the various possible orientations of the femoral stem when mounted within the distal portion of the femur. Those of ordinary skill in the art readily appreciate that the boss mounting surface 30 can be configured to provide any combination of coronal and sagittal plane angulations that are constrained by the foregoing angle ranges.

[0046] The collar 26 can be used with either right or left side knee prostheses. Generally, the collar is positioned such that the angle (α) is to the lateral side of the prosthesis, as measured in the coronal plane. The same collar can be used in either a left or right side prosthesis by simply reversing the orientation of the collar on the prosthesis to ensure a lateral angle for the femoral stem 14.

[0047] With reference to FIG. 6B, the collar peripheral surface 29 has a pair of opposed arcuate sides 29B and a pair of opposed, flat sides 29A. Flat sides 29A are adapted to engage the raised ridges 44C of the boss top surface 44B. The mating contact between the raised ridges 44C and the flat sides 29A of the collar peripheral surface prevents unwanted rotation of the collar when mounted on the boss top surface 44B.

[0048] As illustrated in FIG. 6C, the collar 26 further has a central aperture 34 which seats the bolt shaft 58. The aperture 34 has a funnel-like portion 34A adjacent the boss mounting surface 30, and a cylindrical portion 34B that extends upwardly from the funnel-like portion 34A to the neck 32 of the collar. The funnel-like portion 34A provides an additional clearance space for bolt insertion.

[0049] Referring to FIGS. 1 and 7, the femoral stem 14 has an elongate body 15 that extends along a longitudinal axis (x). A series of spaced flutes 16 are formed along a proximal portion 15A of the body 15, FIG. 1. The flutes 16 inhibit rotation of the stem within the medullary canal of the femur. The bottom portion 15B, e.g., distal end, of the stem body 15 further has a collar and bolt-receiving aperture 16 formed therein. The aperture 16 formed in the stem bottom surface 15C has a first aperture portion 16A having an outer diameter (D3) that is slightly larger that the outer diameter of the first annular surface 32A of the collar, FIG. 5A, thereby allowing the collar neck to mount within the stem aperture 16. The aperture 16 has a second axially spaced portion 16B that has a diameter (D4) that is smaller than diameter (D3) but slightly larger than the diameter (D1) of the bolt shaft 58, FIG. 6A. The aperture further includes a axially spaced, threaded third portion 16C having an outer diameter (D5) that is less than the diameter (D1), but larger than the diameter (D2) of the bolt shaft. This axial successive configuration of the aperture 16 receives the axially spaced portions of the bolt shaft 58A-58C, and allows the bolt threaded portion 58C to threadingly engage with the threaded aperture portion 16C. The outer diameter of the stem bottom portion preferably ranges between about 10 mm and about 20 mm, and most preferably between about 10.5 mm and about 15 mm. The illustrated stem 14 is suitable for use, without modification, in both left and right side prostheses.

[0050] When assembled, the collar 26 is mounted on the top surface 46, e.g., inferior surface, of the boss 44, and the flat sides 66B of the collar are aligned with the raised ridges 44C. The raised ridges prevent unwanted rotation of the collar when mounted thereon. The distal end of the femoral stem is then placed over the neck 32 of the collar 26. In this assembly, the neck portion 32 seats within the first portion 16A of the stem aperture 16, but is not rigidly captured therein. Thus, the stem is rotatable about the stem axis (x) independent of the collar, since the raised ridges of the boss prevent the collar from rotating.

[0051] The securing bolt 56 is then inserted into the boss cavity 70 from the underside of the boss and through the boss aperture 78, such that the bolt shaft extends upwardly from the boss top surface. The spherical engaging surface 62 of the bolt head 60 mates with and engages the similarly configured endwall 76 of the cavity. The selected shape of the cavity endwall allows the bolt shaft to seat within the cavity at an angle that is determined by the collar 26.

[0052] The boss mounting surface 30 of the collar 26

determines the stem angulation and the position at which the bolt shaft protrudes into and extends from the collar 26. The threaded portion 58C of the bolt shaft 58 threadedly engages the threaded portion 16C of the stem aperture and fixedly secures the stem and collar to the femoral component. In this axially successive assemblage, the collar is pressure fitted between the stem and boss by the threaded engagement of the bolt and stem.

[0053] A significant feature of the present invention is the complementary shape of the cavity endwall and the mounting surface of the bolt head, which cooperate to position the bolt at a selected angle determined by the collar mounting angle. The varied positions in which the bolt shaft can be positioned is further facilitated by the selected shape of the aperture, which is preferably elongated in the anterior-posterior direction. Those of ordinary skill in the art will also recognize that the aperture can be elongated in any selected direction in the transverse plane, for example, the medial-lateral direction. In the modular knee prosthesis of the present invention, the bolt shaft of the securing bolt can be centrally located or offset, depending upon the surgeon's needs. Additionally, since the collar is pressure fitted between the stem and bolt, the stem and collar can be separately provided in a packaged modular knee prosthesis. For example, the packaged modular knee prosthesis can include a femoral component, an offset and/or a non offset type bolt, a collar or collars having a 5 degree and/or a 7 degree canted mounting surface, and a femoral stem.

[0054] The modular knee prosthesis 10 of the invention can further include a snap-ring 12, FIG. 1, to provide a redundant mechanism for securing the collar to the femoral stem. The illustrated snap-ring 12 preferably mounts in a circumferential slot formed by the second annular surface 32B of the collar, FIG. 6A, and a corresponding groove formed along the bottom portion of the stem aperture (not shown). The snap-ring seats partially within the circumferential slot within the collar and within the groove formed in the stem, thereby locking the stem onto the collar.

[0055] It will thus be seen that the invention efficiently attains the objects set forth above, among those made apparent from the preceding description. Since certain changes may be made in the above constructions without departing from the scope of the invention, it is intended that all matter contained in the above description or shown in the accompanying drawings be interpreted as illustrative and not in a limiting sense.

[0056] It is also to be understood that the following claims are to cover all generic and specific features of the invention described herein, and all statements concerning of the scope of the invention which, as a matter of language, might be said to fall therebetween.

Claims

1. A modular knee prosthesis (10) comprising

   a femoral component (40, 40', 40") having a pair of spaced apart condylar portions (42A, 42B) each having a superior articulation surface (45) and an inferior surface (46), the femoral component further including a boss structure (44, 44', 44") disposed between and connecting the condylar portions (42A, 42B), the boss structure (44) having an inferior surface (44B) that extends, in a first orientation, generally horizontally in a transverse plane, and an opposed superior surface, wherein an aperture having a selected configuration extends between the inferior (44B) and superior (44D) surfaces of the boss structure (44);

   an elongate stem member means (14) for mounting within the medullary canal of a distal portion of a femur, the stem member (14) having a closed proximal end (15A) and an open distal end (15B);

   a collar means (26) for mounting upon the external end (15B) of the stem member (14), the collar means (26) having a distal surface (30) that is substantially transverse to a longitudinal axis of the stem member (14) when mounted thereon, the collar distal surface (30) and the inferior surface (44B) of the boss structure (44) defining a selected mounting angle therebetween; and

   at least one securing bolt (56) for mounting within the aperture (78) of the boss structure, characterised in that the securing bolt (56) has a head portion (60) with a spherical first surface (62) from which an elongate shaft portion (58) extends, wherein said shaft portion (58) of the bolt (56) is disposed at and extends from a non-centrally located position on the head portion (60).

2. The knee prosthesis (10) of claim 1 wherein the elongate shaft portion (58) is offset a selected distance, preferably 0.1 mm to 5 mm, in the transverse plane, in an anterior-posterior direction from a centrally located position on the bolt head portion (60).

3. The knee prosthesis (10) of claim 1 or 2 wherein the distal end (15B) of the elongate stem member (14) includes a receiving means (16) for receiving and engaging the shaft portion (58) of the bolt (56).

4. The knee prosthesis (10) of claim 3 wherein the receiving means (16) includes a cavity, at least a portion of which is threaded and preferably at least a portion of the bolt shaft (58) is threaded so as to matingly engage a threaded portion (16C) of the

cavity.

5. The knee prosthesis (10) of any one of claims 1 to 4 wherein the securing bolt (56) is mountable within the collar means (26) such that the spherical first surface (62) of the head portion (60) engages the aperture (78) of the boss (44), wherein the mounting angle of the collar means (26) determines the angle at which the bolt shaft (58) portion extends from the inferior surface (44A) of the boss structure (44).

6. The knee prosthesis (10) of any one of claims 1 to 5 wherein the mounting angle of the distal end (30) of the collar means (26) is in the range of 0 degrees to 15 degrees either in the medial-lateral direction in the transverse plane, to the medial or lateral side or in the anterior-posterior direction in the transverse plane, to the anterior or posterior side.

7. The knee prosthesis (10) of any one of claims 1 to 6 wherein the head portion (60) of the bolt (56) includes a first anti-rotation means (66B) for preventing rotation of the bolt when mounted within the boss aperture (78).

8. The knee prosthesis (10) of claim 7 wherein the boss structure (44) further includes a second anti-rotation means (74), which engages the first anti-rotation means of the bolt, for preventing rotation of the bolt (56) when mounted within the boss aperture (78), the second anti-rotation means (76) being formed on the superior surface (44D) of the boss structure (44).

9. The knee prosthesis (10) of any one of claims 1 to 8 wherein the collar (26) includes a third anti-rotation means (29A) for preventing rotation of the collar (26) when mounted on the inferior surface (44B) of the boss structure (44).

10. The knee prosthesis (10) of claim 9 wherein the inferior surface of the boss structure (44B) includes a fourth anti-rotation means (44C), which engages the third anti-rotation means (29A) of the collar, for preventing rotation of the collar (26) when mounted on the boss structure (44), the fourth anti-rotation means (44C) being formed on the inferior surface (44A) of the boss structure (44).

11. The knee prosthesis (10) of any one of claims 1 to 10 wherein the aperture (78) formed within the inferior surface (44B) of the boss structure (44) has a selected shape that is elongated in at least one of an anterior-posterior direction and a medial-lateral direction in the transverse plane.

12. The knee prosthesis (10) of any one of claims 1 to 11 further comprising locking means, preferably comprising a snap-ring (12), for securing the collar means (26) to the elongated stem member (14), the locking means being disposed in an interference fit with the collar means (26) and the stem (14).

13. The knee prosthesis (10) of any one of claims 1 to 12 wherein the elongate stem member (14) is rotatable about its longitudinal axis independent of the collar means (26).

14. The knee prosthesis (10) of any one of claims 1 to 13 wherein the collar means (26), the elongate stem member (14) and/or the securing bolt (56) are suitable for use, without modification, in right or left side prostheses.

Patentansprüche

1. Modulare Knieprothese (10), die umfaßt:

eine Oberschenkelkomponente (40, 40', 40"), die ein Paar mit Abstand angeordnete kondyläre Bereiche (42A, 42B) aufweist, von denen jeder eine oben liegende Gelenkfläche (45) und ein unten liegende Fläche (46) hat, wobei die Oberschenkelkomponente ferner eine Vorsprungsstruktur (44, 44', 44") umfaßt, die zwischen den kondylären Bereichen (42A, 42B) angeordnet ist und diese verbindet, und wobei die Vorsprungsstruktur (44) eine unten liegende Fläche (44B), die sich in einer ersten Ausrichtung im wesentlichen horizontal in einer Querebene erstreckt, und eine gegenüber angeordnete, oben liegende Fläche aufweist, wobei sich eine Öffnung mit einer ausgewählten Konfiguration zwischen der unten liegenden (44B) und der oben liegenden (44D) Fläche der Vorsprungsstruktur (44) erstreckt;
eine längliche Schaftelementvorrichtung (14) zum Befestigen innerhalb des Markkanals eines distalen Bereiches eines Oberschenkelknochens, wobei das Schaftelement (14) ein geschlossenes proximales Ende (15A) und ein offenes distales Ende (15B) aufweist; ein Hülsenmittel (26) zum Befestigen des äußeren Endes (15B) des Schaftelements (14) darauf, wobei das Hülsenmittel (26) eine distale Fläche (30) aufweist, die im wesentlichen quer zu einer Längsachse des Schaftelements (14) verläuft, wenn es auf diesem befestigt ist, und wobei die distale Fläche (30) der Hülse und die unten liegende Fäche (44B) der Vorsprungsstruktur (44) einen ausgewählten Befestigungswinkel zwischen ihnen definiert; und
wenigstens einen Sicherungsbolzen (56) für eine Befestigung innerhalb der Öffnung (78) der Vorsprungsstruktur,

dadurch gekennzeichnet, daß
der Sicherungsbolzen (56) einen Kopfbereich (60) mit einer sphärischen ersten Fläche (62) aufweist, von der sich ein länglicher Schaftbereich (58) erstreckt, wobei der Schaftbereich (58) des Bolzens (56) an einer nicht zentral angeordneten Position auf dem Kopfbereich (60) angeordnet ist und sich von dieser erstreckt.

2. Knieprothese (10) nach Anspruch 1, wobei der längliche Schaftbereich in der Querebene von einer zentral angeordneten Position auf dem Bolzenkopfbereich (60) um einen ausgewählten Abstand, bevorzugt 0,1 mm bis 5 mm in der Querebene in einer Vor-Rück-Richtung (Anterior-Posterior-Richtung) versetzt ist.

3. Knieprothese (10) nach Anspruch 1 oder 2, wobei das distale Ende (15B) des länglichen Schaftelements (14) ein Aufnahmemittel (16) zur Aufnahme von und für einen Eingriff mit dem Schaftbereich (58) des Bolzens (46) umfaßt.

4. Knieprothese (10) nach Anspruch 3, wobei das Aufnahmemittel (16) einen Hohlraum umfaßt, von dem wenigstens ein Teil mit einem Gewinde versehen ist und wobei bevorzugt wenigstens ein Teil des Bolzenschafts (58) mit einem Gewinde versehen ist, so daß dieses passend mit einem mit einem Gewinde versehenen Bereich (16C) des Hohlraums in Eingriff steht.

5. Knieprothese (10) nach einem der Ansprüche 1 bis 4, wobei der Sicherungsbolzen (56) innerhalb der Hülsenvorrichtung (26) so befestigbar ist, daß die sphärische erste Fläche (62) des Kopfbereichs (60) mit der Öffnung (78) des Vorsprungs (44) in Eingriff steht, wobei der Befestigungswinkel des Hülsenmittels (26) den Winkel bestimmt, in dem sich der Bolzenschaftbereich (48) von der unten liegenden Fläche (44A) der Vorsprungsstruktur (44) erstreckt.

6. Knieprothese (10) nach einem der Ansprüche 1 bis 5, wobei der Befestigungswinkel des distalen Endes (30) des Hülsenmittels (26) in einem Bereich von 0 Grad bis 15 Grad liegt, entweder in der Mitten-Seiten-Richtung (Medial-Lateral-Richtung) in der Querebene in Richtung auf die in der Mitte liegende oder die laterale Seite oder in der Vor-Rück-Richtung (Anterior-Posterior-Richtung) in der Querebene in Richtung auf die vorne liegende oder die hinten liegende Seite.

7. Knieprothese (10) nach einem der Ansprüche 1 bis 6, wobei der Kopfbereich (60) des Bolzens (56) ein erstes Antirotationsmittel (66B) zum Verhindern einer Drehung des Bolzens umfaßt, wenn dieser in der Vorsprungsöffnung (78) befestigt ist.

8. Knieporthese (10) nach Anspruch 7, wobei die Vorsprungsstruktur (44) ferner ein zweites Antirotationsmittel (74) umfaßt, welches mit dem ersten Antirotationsmittel des Bolzens zum Verhindern einer Drehung des Bolzens (56) in Eingriff steht, wenn es in der Vorsprungsöffnung (78) befestigt ist, wobei das zweite Antirotationsmittel (76) an der oben liegende Fläche (44D) der Vorsprungsstruktur (44) ausgebildet ist.

9. Knieprothese (10) nach einem der Ansprüche 1 bis 8, wobei die Hülse (26) ein drittes Antirotationsmittel (29A) zum Verhindern einer Drehung der Hülse (26) umfaßt, wenn diese auf der unten liegenden Fläche (44B) der Vorsprungsstruktur (44) befestigt ist.

10. Knieprothese (10) nach Anspruch 9, wobei die unten liegende Fläche der Vorsprungsstruktur (44B) ein viertes Antirotationsmittel (44C) umfaßt, welches mit dem dritten Antirotationsmittel (29A) der Hülse zum Verhindern einer Drehung der Hülse (26) in Eingriff steht, wenn sie mit der Vorsprungsstruktur (44) verbunden ist, wobei das vierte Antirotationsmittel (44C) auf der unten liegenden Fläche (44A) der Vorsprungsstruktur (44) ausgebildet ist.

11. Knieprothese (10) nach einem der Ansprüche 1 bis 10, wobei die Öffnung (78), die in der unten liegenden Oberfläche (44B) der Vorsprungsstruktur (44) ausgebildet ist, eine ausgewählte Form aufweist, die in der Querebene in wenigstens eine der Richtungen, einer Anterior-Posterior-Richtung und einer Medial-Lateral-Richtung, verlängert ist.

12. Knieprothese (10) nach einem der Ansprüche 1 bis 11, die ferner ein Verriegelungsmittel umfaßt, bevorzugt einen Sicherungssring (12) zum Sichern des Hülsenmittels (26) an dem länglichen Schaftelement (14) umfaßt, wobei das Verriegelungsmittel in einer Preßpassung mit dem Hülsenmittel (26) und dem Schaft (14) angeordnet ist.

13. Knieprothese (10) nach einem der Ansprüche 1 bis 12, wobei das längliche Schaftelement (14) unabhängig von dem Hülsenmittel (26) um seine Längsachse drehbar ist.

14. Knieprothese (10) nach einem der Ansprüche 1 bis 13, wobei das Hülsenmittel (26), das längliche Schaftelement (14) und/oder der Sicherungsbolzen (56) ohne eine Modifikation für eine Verwendung in Prothesen für eine linke Seite oder für eine rechte Seite geeignet sind.

Revendications

1. Prothèse de genou modulaire (10) comprenant :

   - un composant fémoral (40, 40', 40") ayant une paire de portions condyliennes espacées (42A, 42B) qui ont chacune une surface d'articulation supérieure (45) et une surface inférieure (46), le composant fémoral comprenant en outre une structure de bossage (44, 44', 44") disposée entre les portions condyliennes (42A, 42B) et reliant ces dernières, la structure de bossage (44) ayant une surface inférieure (44B) qui s'étend, dans une première orientation, généralement horizontalement dans un plan transversal, et une surface supérieure opposée, dans laquelle une ouverture ayant une configuration choisie s'étend entre les surfaces inférieure (44B) et supérieure (44D) de la structure de bossage (44) ;

   - un moyen formant élément broche allongé (14) destiné à être monté dans le canal médullaire d'une portion distale d'un fémur, l'élément broche (14) ayant une extrémité proximale fermée (15A) et une extrémité distale ouverte (15B);

   - un moyen formant bague (26) destiné à être monté sur l'extrémité extérieure (15B) de l'élément broche (14), le moyen formant bague (26) ayant une surface distale (30) qui est sensiblement transversale à un axe longitudinal de l'élément broche (14) lorsqu'il est monté sur celui-ci, la surface distale (30) de la bague et la surface inférieure (44B) de la structure de bossage (44) définissant entre elles un angle de montage choisi ; et

   - au moins une vis de fixation (56) destinée à être montée dans l'ouverture (78) de la structure de bossage, caractérisée en ce que la vis de fixation (56) a une portion tête (60) munie d'une première surface sphérique (62) à partir de laquelle s'étend une portion fût allongée (58), dans laquelle ladite portion fût (58) de la vis (56) est disposée dans une position décentrée sur la portion tête (60) et s'étend à partir de cette position.

2. Prothèse de genou (10) selon la revendication 1, dans laquelle la portion fût allongée (58) est décalée d'une distance choisie, de préférence de 0,1 mm à 5 mm, dans le plan transversal, dans une direction antéro-postérieure, par rapport à une position centrée sur la portion tête (60) de la vis.

3. Prothèse de genou (10) selon la revendication 1 ou 2, dans laquelle l'extrémité distale (15B) de l'élément broche allongé (14) comprend un moyen de réception (16) destiné à recevoir la portion fût (58) de la vis (56) et à entrer en prise avec elle.

4. Prothèse de genou (10) selon la revendication 3, dans laquelle le moyen de réception (16) comprend une cavité, dont au moins une portion est filetée et au moins une portion du fût (58) de la vis est de préférence filetée de manière à entrer en prise avec une portion filetée (16C) de la cavité, en s'y accouplant.

5. Prothèse de genou (10) selon une quelconque des revendications 1 à 4, dans laquelle la vis de fixation (56) peut être montée dans le moyen formant bague (26) de telle manière que la première surface sphérique (62) de la portion tête (60) coopère avec l'ouverture (78) du bossage (44), dans laquelle l'angle de montage du moyen formant bague (26) détermine l'angle selon lequel la portion fût (58) de la vis s'étend à partir de la surface inférieure (44A) de la structure de bossage (44).

6. Prothèse de genou (10) selon une quelconque des revendications 1 à 5, dans laquelle l'angle de montage de l'extrémité distale (30) du moyen formant bague (26) est dans l'intervalle de 0 degré à 15 degrés, soit dans la direction médiale-latérale dans le plan transversal, vers le côté médial ou latéral, soit dans la direction antéro-postérieure dans le plan transversal, vers le côté antérieur ou postérieur.

7. Prothèse de genou (10) selon une quelconque des revendications 1 à 6, dans laquelle la portion tête (60) de la vis (56) comprend un premier moyen anti-rotation (66B) destiné à empêcher la rotation de la vis lorsqu'elle est montée dans l'ouverture (78) du bossage.

8. Prothèse de genou (10) selon la revendication 7, dans laquelle la structure de bossage (44) comprend en outre un deuxième moyen anti-rotation (74) qui coopère avec le premier moyen anti-rotation de la vis, pour empêcher la rotation de la vis (56) lorsqu'elle est montée dans l'ouverture (78) du bossage, le deuxième moyen anti-rotation (76) étant formé sur la surface supérieure (44D) de la structure de bossage (44).

9. Prothèse de genou (10) selon une quelconque des revendications 1 à 8, dans laquelle la bague (26) comprend un troisième moyen anti-rotation (29A) destiné à empêcher la rotation de la bague (26) lorsqu'elle est montée sur la surface inférieure (44B) de la structure de bossage (44).

10. Prothèse de genou (10) selon la revendication 9, dans laquelle la surface inférieure (44B) de la struc-

ture de bossage comprend un quatrième moyen anti-rotation (44C) qui coopère avec le troisème moyen anti-rotation (29A) de la bague pour empêcher la rotation de la bague (26) lorsqu'elle est montée sur la structure de bossage (44), le quatrième moyen anti-rotation (44C) étant formé sur la surface inférieure (44A) de la structure de bossage (44).

11. Prothèse de genou (10) selon une quelconque des revendications 1 à 10, dans laquelle l'ouverture (78) formée dans la surface inférieure (44B) de la structure de bossage (44) a une forme choisie qui est allongée dans au moins une des directions suivantes, une direction antéro-postérieure et une direction médiale-latérale, dans le plan transversal.

12. Prothèse de genou (10) selon une quelconque des revendications 1 à 11, comprenant en outre un moyen de verrouillage, qui comprend de préférence une bague d'arrêt (12) pour fixer le moyen formant bague (26) à l'élément broche allongé (14), le moyen de verrouillage étant disposé en ajustement à serrage par rapport au moyen formant bague (26) et à la broche (14).

13. Prothèse de genou (10) selon une quelconque des revendications 1 à 12, dans laquelle l'élément broche allongé (14) est capable de tourner autour de son axe longitudinal indépendamment du moyen formant bague (26).

14. Prothèse de genou (10) selon une quelconque des revendications 1 à 13, dans laquelle le moyen formant bague (26), l'élément broche allongé (14) et/ou la vis de fixation (56) sont appropriés pour être utilisés, sans modification, dans des prothèses du côté droit ou du côté gauche.

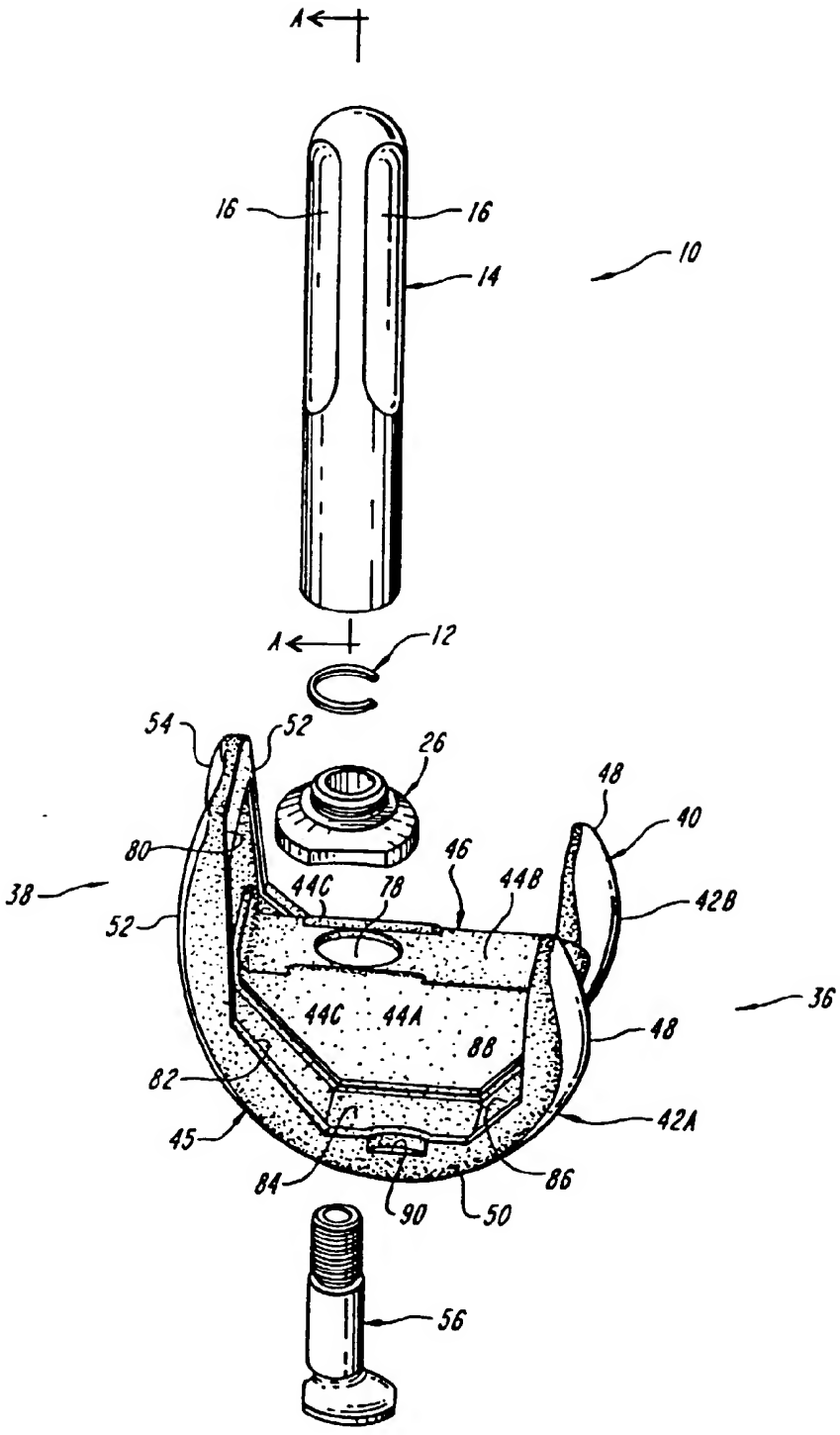
A
16
16
14
10
A
12
54
52
26
48
40
80
46
38
44C
78
44B
42B
52
36
44C
44A
88
48
82
42A
45
84
86
90
50
56

FIG. 1

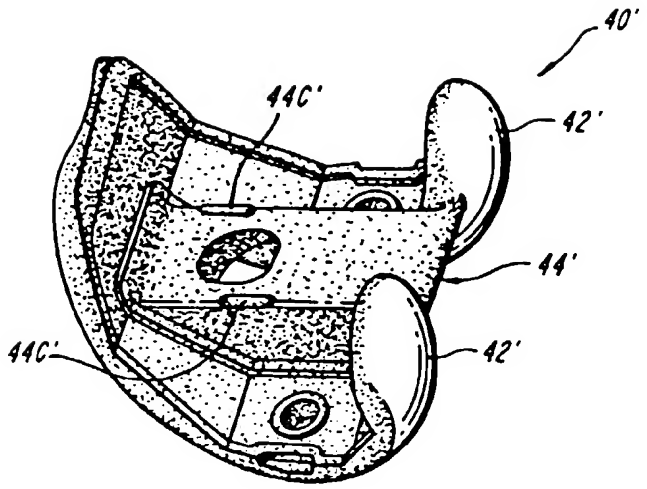

FIG. 2A

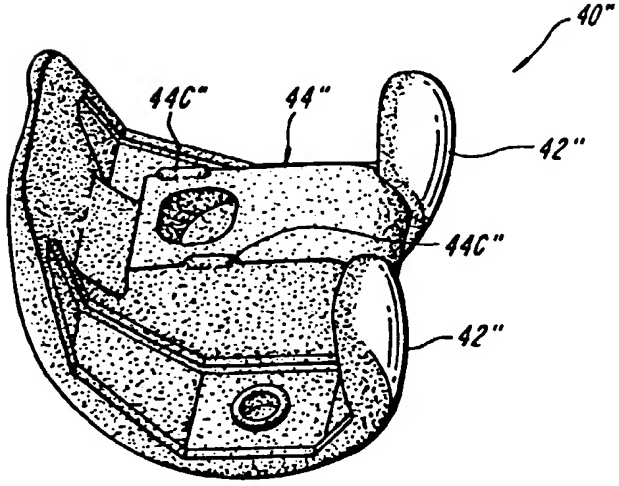

FIG. 2B

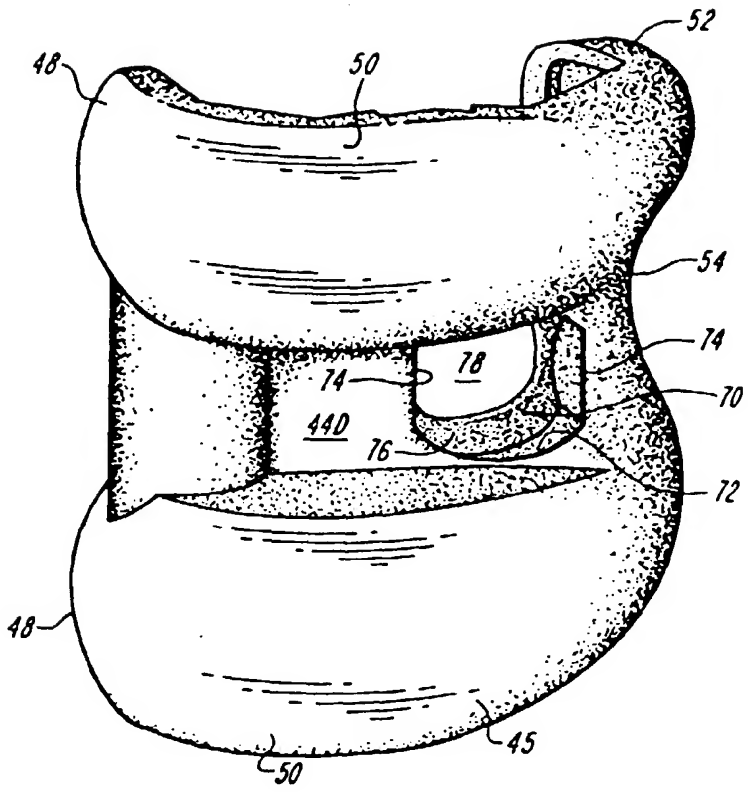

FIG. 3

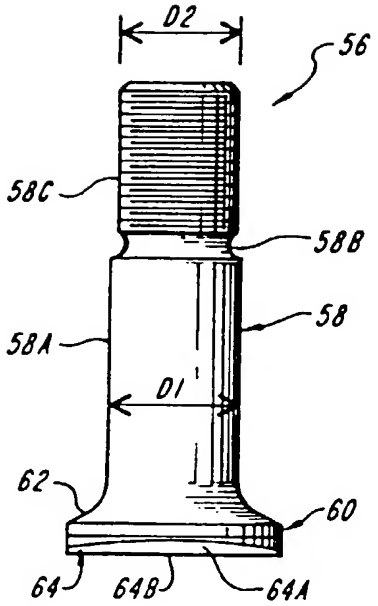

FIG. 4A

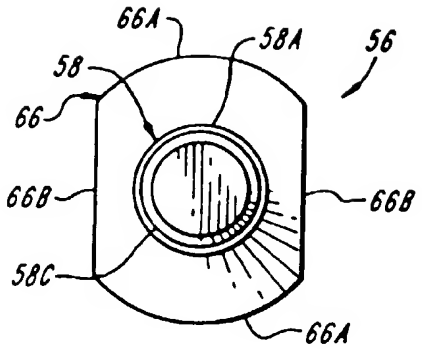

FIG. 4B

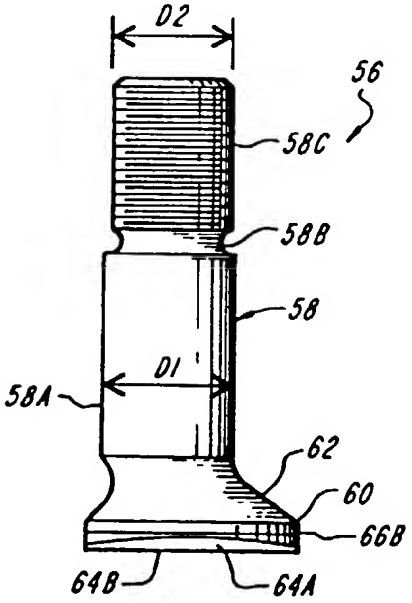

FIG. 5A

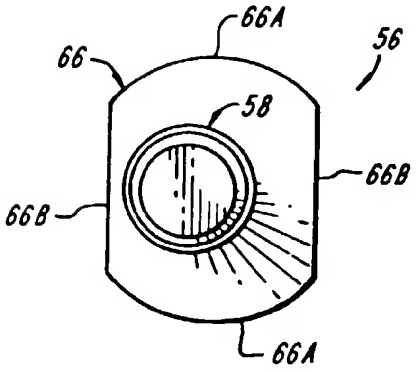

FIG. 5B

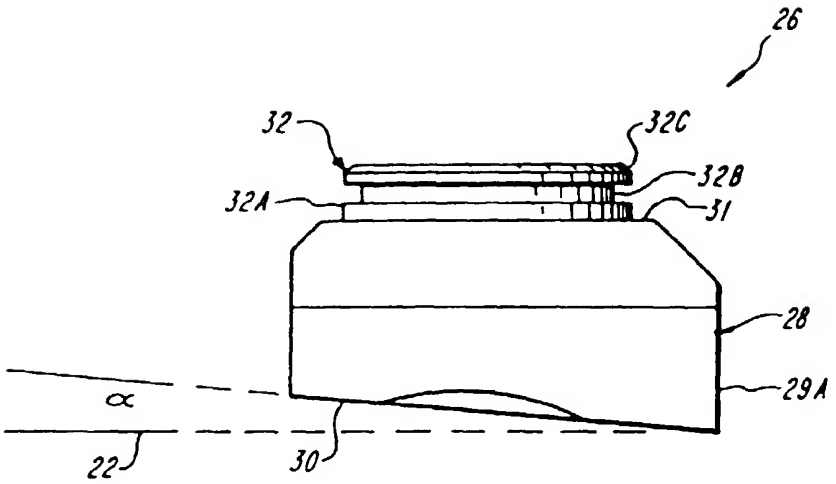
26
32
32C
32B
32A
31
28
29A
α
22
30

FIG. 6A

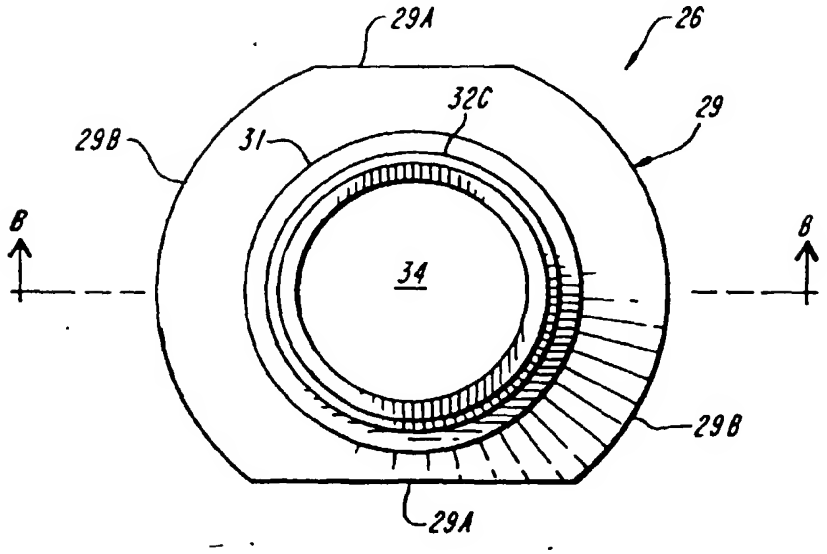
29A
26
32C
29
29B
31
B
B
34
29B
29A

FIG. 6B

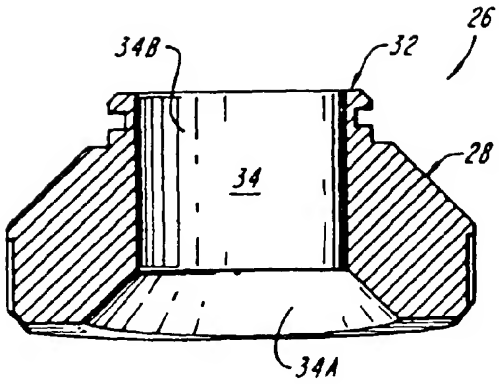

FIG. 6C

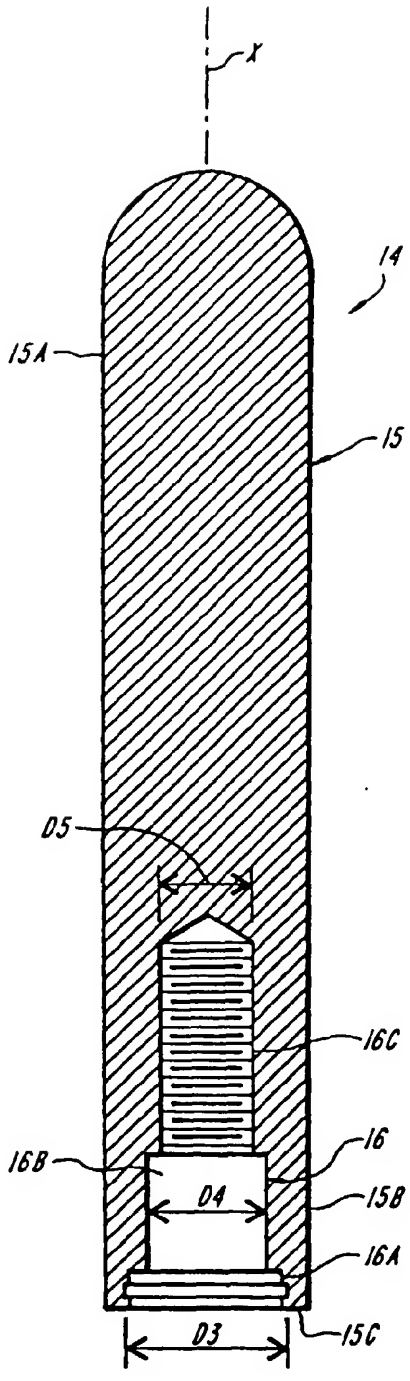

FIG. 7